
Technological Factors and Management Transformation in Social and Economic Systems

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Abstract:

Today, a rapid, interconnected change in a large number of factors that have a significant impact on development of enterprises makes uncertainty an ongoing reality of management.

As a key driver of change, new technologies enter new areas of life; global market, common information space, and reduction in product life cycles enhance competition and demand new higher standards from enterprises and their staffs. Development of management theory and practice does not meet the requirements set by the business environment.

Transformation of management and its basic subsystems becomes a recognized need. Effective management in contemporary business landscape involves a combination of flexibility and adaptability, which does not exclude a certain level of stability as a prerequisite to obtain competencies. Therefore, from a strategic point of view, the main task of modern management is to find a balance of stability and flexibility, that will make an effective management real. "What" needs to be done is shown in studies in a consistent manner. At the same time, "how" to do that is mostly described in general words.

The author believe that one must answer the "why" question first: an understanding why we should change, i. e. what factors affect transforming management of economic and social systems, and how they do that is an initial stage of successful adaptation the existing management concepts and practices.

The article describes the characteristics of impact of technological factors on the management, which makes the change processes controllable and improves the management effectiveness.

Keywords: *adaptation and transformation in management; balancing stability and flexibility; technological factors; knowledge technology and machine technology; modern business environment.*

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1. Introduction

Today, in the context of a “new economy” based on continuous developing of products, technological and organizational innovations, a strategic competitive advantage is built at the level of business processes, an efficient operation of which depends on the quality of management (Gafurov *et al.*, 2012). The issue of discrepancy between the traditional ordinary management and today’s economic realities is becoming more and more evident. In response to this in management practice and theory, research papers appear that aim at finding an answer to the following question: *“How to make sure that management is effective in a multi-factor, dynamically changing business environment with a high level of uncertainty?”* e.g., a review of “strategic flexibility” concepts by Lindgren and Bandkhold (2009), “strategic maneuvering” (D'Aveni, 1994), “strategic reactivity” (Bettis and Hitt, 1995), “dynamic core capability” (Lei *et al.*, 1996), “dynamic potential” (Teece *et al.*, 1997), “constant innovation” (Chakravarthy, 1997), “strategic flexibility” (Hitt *et al.*, 1998; Hamel, 2000), “OODA cycle” (Haeckel and Nolan, 1993; Blaxill and Hout, 1998), “innovation of strategy” (Hamel, 1998), “competition on the edge” (Brown and Eisenhardt, 1998), “healthy” adaptability” (Beinhocken, 1999), “business in “funky style” (Nordstrom and Ridderstrale, 1999).

In summary, the key challenge of modern strategic management can be defined as the need to find and keep a balance of stability and flexibility that will make it possible to implement the enterprise objectives effectively.

The need to find a balance of contradictory, sometimes mutually exclusive characteristics and trends in management system is also reflected in its subsystems. For example, the classic dilemma of control lies in finding a balance between the desire to increase the predictability of staff performance and the desire to develop an initiative and creative attitude to work in employees, as well as the ability to respond to changes quickly and adequately. If the first trait implies strengthening of administration and control, staff actions and behavior control, the second one requires mild forms of performance control. With respect to economic entities, the classic dilemma of control is manifested in the search for a balance of centralization and decentralization in a management system (Mullakhmetov, 2013a).

Knowing the key factors causing management changes makes it possible to make processes of changes controllable, and it is also one of the requirements for the effectiveness of management in existing conditions. The factors of management transformation are a number of persistent groups for their root causes. Our previous studies (Mullakhmetov, 2013b; 2013c), (Mullakhmetov *et al.*, 2016b; 2018a; 2018b; 2018c; 2018d), (Sadriev *et al.*, 2016b; 2017), (Krotkova *et al.*, 2016), (Latyshev and Akhmetshin, 2015) and a review of colleagues’ research reports allowed us to identify the following generalized groups.

- 1) Technological advances, development of technology and new activities (technological factors).
- 2) Qualitative and quantitative changes in the workforce (human capital).
- 3) Integration processes, amplified by globalization, increase in the speed of information sharing, transport accessibility, etc. (integration factors).
- 4) Qualitative changes of the society, changes in the previously existing value systems (sociocultural factors).

Technological factors are more tangible and the most easy to identify. The group of technological factors is a consequence of technological advances, and, in turn, leads to the appearance of other factors that all together, with reference to each other, cause the need to transform the existing management systems, technologies, methods and tools.

For example, because of the efforts of German businessmen, politicians and scientists, the concept of “Industry 4.0” formulated in 2011 is based on 9 technological achievements: autonomous robots, big data, augmented reality, modeling, additive technologies, horizontal and vertical integration, cloud technologies, industrial Internet of things, information security (Lipkin, 2017). At the same time, Industry 4.0 is seen as a means of increasing competitiveness by enhanced integration of cyber-physical systems into production processes: robots become more autonomous, flexible and able to interact with people (Rüßmann *et al.*, 2015); with the Internet of things introduced in the industry, more devices will be equipped with built-in computing systems and combined with standard technologies, etc., (O’Marah, 2015).

2. Methodology

At the end of the 19th century, management emerged as a “science of efficiency”. The fundamental task of management is to increase the effectiveness of a management subject (Cummings, 2010).

Daft (2009) emphasizes that the manager’s duty is to use resources to achieve the objectives of the enterprise efficiently and reasonably. In the author’s opinion, to achieve that, managers should have three skill groups, the priority and correlation of which depends on management levels (i.e. on the scope of managers’ activities and the nature of management decisions taken):

- conceptual skills (cognitive abilities of a person to perceive the enterprise as a whole and, at the same time, clearly distinguish the interrelation of its parts);
- HR skills (the manager’s ability to work with people or with their direct involvement, as well as the ability to interact effectively as a team member);
- technical skills (special knowledge and skills necessary for performance, i. e. skills of using the methods, technology and equipment when performing special functions).

Possessing technical skills involves the manager's professional knowledge, analytical skills, and the ability to use tools and other means correctly to solve problems in the particular area. Technical skills are of key importance at grassroots organizational levels. As we move along the hierarchy steps, the need for them decreases and the importance of HR skills and conceptual skills increases (Daft, 2009). The concept of technology is interpreted as and includes:

- physical aspects of machines, equipment and manufacturing systems involved in the process of transformation of inputs into the final product (machine technology);
- the actual methods, systems and procedures used in performance of work in the process of transformation (knowledge technology) (Mullins, 2003).

The first component can be regarded as the technical level of machines and mechanisms – the possibility of applying advanced methods of inputs processing (Korableva *et al.*, 2018); the second component can be seen as a level of technological processes of resource transformation, the application of which requires an appropriate technical level of equipment. As you can see, the components of process technology have a strong correlation, and the process effectiveness is achieved when their level is high and there is a balance of their development levels.

There are an immense number of definitions of technology, while none is generally accepted. The main approaches to the definition of this category in the organizational context are as follows:

- 1) *Technological determinism*: Essence: technologies and their effect objectively exist and are an autonomous organizing force (Knights and Murray, 1994). The main objective of this approach is to assess how great the interrelation between the efficiency of the enterprise and its structure is, depending on the manufacturing technology used. Within the organizational theory, technological determinists argued that manufacturing technologies determined the structure of enterprise and the behavior of people within it, regardless of specific context (Zuboff, 1988).
- 2) *The concept of sociotechnical system* provides a link between the systemic approach and individual ideas of the technological approach and does not consider the technology itself as a behavior determinant. The main goal of the concept is to find the best model of interaction between social (psychological and social needs of the staff) and technical (equipment and its physical location) elements of the organizational system. An approach aimed at balancing the social and technical components and their requirements is needed to build an effective model of the sociotechnical system. "The final model is a matter of enterprises' choice, but not a technical imperative" (Buchanan and Huczynski, 1997).
- 3) *Socio-economic formation of technologies*: Technologies are seen as an object of impact by economic, technical, political, social conditions in which it is modeled, developed and used (under the concept of technological determinism, technology is the subject of the impact, i.e. the active factor). These factors shape

technology, and therefore technology alone does not have an “impact” (MacKenzie and Wajcman, 1985).

- 4) *In many respects, procedural approaches* emphasize the assumption that the results of technological changes are the consequence of social choice and are determined by the actors of the enterprise, rather than the logic of capitalist development or external imperatives of a technical or market nature. *“Technology is more of an opportunity than a direction, and decisions or choices affect the way technology is used, but not technology itself, which affects the performance of an enterprise”* (Buchanan and Boddy, 1983).
- 5) *Radical approaches*: The following idea is key: not technology itself reduces qualification requirements (typical for the concept of technological determinism), but rather the following occurs: *“... technologies are entirely the result of the need to control the labor process in order to increase profits. Advanced technology will complement rather than replace human skills and abilities, that is, the form of working enterprise and control cannot be introduced without global political, economic and social transformation”* (McLoughlin and Clark, 1994).

Let us consider the category of “new technology” as a reason of technological advances. Examples of new technologies are shown in Figure 1. (Mullins, 2003).

Figure 1. Examples of New Technologies

Examples of New Technologies	
Advanced Manufacturing Technologies	Information Technology
Numerical control machine tools	Word processing / personal computers
Robotic engineering	Intelligent knowledge-based systems
Computer-aided design and drafting	Mainframes, mini- and microcomputers used offline or online (local, global networks, Internet, etc.)
Flexible manufacturing systems	Teleconferences
Computer-aided manufacturing	Video conferences
Computer-aided manufacturing planning and invention control systems	Service Delivery
Raw material requirements planning	Automated teller machines
Manufacturing requirements planning	E-payments
Goods	EDI
Pocket calculators	Electronic point of sale
LCD watches	Teletext
Electronic games	Patient monitoring systems

New technologies are flexible, so they provide a wide choice as to how to use them in the enterprise to influence working practices, qualifications and control, as well as work design process (Nikolaeva and Pak, 2017). This flexibility is the result of a combination of four key characteristics:

- compactness;
- low maintenance;

- price reduction with increasing opportunities;
- flexibility in use (re-programmability for different uses).

3. Results

In today's business, where the contribution of tangible assets to the creation and preservation of competitive advantage is steadily declining, the ability of human capital to initiate, introduce, perceive, and use new technologies is a strategic resource that decisively determines a company's competitive advantage. Accordingly, importance of knowledge technology, one of the constituents of technology as such, is also growing. The ability of business management to learn faster than others from the experience of change becomes a strategic direction of creating a competitive advantage.

Due to modern business environment characteristics our forecasting capabilities are shrinking. However, the loss of forecasting and planning opportunities can be compensated by flexibility (adaptability). New technologies represent a certain degree of flexibility and new opportunities for workplace organization. Technologies become an independent organizational factor that influences the nature of work and its performance methods.

At the grassroot (operational) management level, technologies formalized by organizational and technical internal regulatory documents (company standards, standard management procedures, technological processes of transforming resources into finished products, instructions, etc.) form the desired state of objects and management processes (expected results, performance standards, interim results, etc.) and thereby create an opportunity to implement system monitoring of objects and processes (Mullakhmetov, 2015). In this context, technologies ensure the process ordering and process stability, thereby building up competencies for the quality implementation of processes and performance of works.

Due to their characteristics, new technologies are most needed for solving the problem of stability and flexibility balance: first, the multivariance of their use allows management to adapt to changes in business environment by applying them in various situations; secondly, technologies, acting as performance standards and action algorithms, guarantee the possibility of their implementation and obtainment of an acceptable result. Therefore, new technologies become a pre-requisite for ensuring effective management in today's business environment.

The ways to use new technologies at an enterprise and, therefore, the factors that influence working with technology have much in common with the economic and social processes that managers face. For example, the process of adoption and introduction of new technologies, with its procedures detailed, in many respects repeats the generally accepted procedures for the preparation, adoption and implementation of management decisions (Mullakhmetov, 2016a).

Technologies are a group of factors that have the greatest impact on performance of the organization's operating systems. Therefore, technologies in many ways determine efficiency and become a key link in solving the fundamental task of management (improving the efficiency of the management object) in the context of innovative development.

4. Discussion

The impact of technological factors on management and its subsystems is most often demonstrated by the example of information technology (IT). Daft believes that information technology improves communication processes with counterparties and, within an enterprise, has a generally positive effect on management practices; however, they can create some issues. For managers, the main consequences of IT implementation include cooperation improvement, increased employee performance and productivity, as well as granting of new powers to employees and the possibility of information overload (Daft, 2009).

When introducing IT for the effective use of their potential for business purposes, it is important to prioritize correctly. Tricker stressed that *"... the main issues center around management and organization, and not in the computer field ... the choice should be made guided by the needs of business rather than computer systems"* (Tricker, 1980). It is also necessary to remember that computers do not free from the need to think, they speed up the processes determined by a person. A quick and qualitative solution of incorrectly formulated problems still does not lead to the desired results. As the English philosopher and writer Gilbert Chesterton (1874-1936) said, *"... it isn't that they can't see the solution. It is that they can't see the problem"* (McGoff, 2012).

Frances Cairncross, editor-in-chief at The Economist and head of the National Institute of Economics and Social Research, offers a picture of how a change in communication technologies will affect the transformation of the economy, commerce, and politics in his book *The Death of Distance*. The author believes that disappearance of distances that determine the price of communications is likely to become the only important economic force that forms the society in early 2000s (Cairncross, 1997).

Manuel Castells in his trilogy *"The Information Age: Economy, Society and Culture"* declares the emergence of a *"network society"* characterized by globalization of strategically decisive economic activities, flexibility and instability of work, and individualized labor. The author emphasizes that the information technology revolution increases its potential, contributing to changes and thus freeing up its productivity. The book examines the process of globalization, which has jeopardized entire countries, having excluded them from information networks. According to Castells, the 21st century will not give most people the prosperity

promised by an unprecedented technological revolution in history; most likely, information chaos will become its feature (Castells, 1996; 1997; 1998).

Geoffrey Moore, president of The Chasm Group, providing high-tech consulting services, in his book “Crossing the Chasm”, offered a technology adoption life-cycle model (Moore, 2001). The model was created specifically for the high-tech market and subsequently adapted for various areas. The model includes five groups of market participants:

- innovators – techies;
- early adopters – visionaries;
- early majority – pragmatists;
- late majority – conservatives;
- laggards – skeptics.

The group characteristics, given in the form of brief definitions, form the basis of the following model – Moore’s high-tech marketing model. According to it, development of the high-tech market initially requires focusing efforts on innovators, building up the market, and then switching to early adopters and so on, until the late majority and laggards. According to Moore: “... *it is important to maintain inertia to create a domino effect, like the train, and to ensure the natural desire of the next group to buy the product*”. Another reason for maintaining inertia is to “...*take advantage of today, because everything can become obsolete tomorrow*” (Moore, 2001).

As our previous studies show, small enterprises play an important role in the creation of new technologies and opportunities for innovation. In countries leading in terms of innovative development, small enterprises provide the market with more than half of all new ideas. In economically developed countries, the innovations adoption rate for small enterprises is on average one third higher than that for large enterprises (Krotkova *et al.*, 2016).

5. Conclusions

Today, the researchers of management problems unanimously point out to the revolutionary changes in the business environment as a key factor determining the development of management (Sadriev *et al.*, 2016a). This statement, which has actually become an axiom, is based on interrelation between economic processes and the processes of management thereof, discovered by the ancient Greeks.

Modern business environment presents ever new, increased requirements for management in economic and social systems. The problem of the discrepancy between the current practice of traditional management and today’s realities of the economy is becoming more and more evident. Effective management capable of providing and supporting competitive advantages in a multifactor, dynamically

changing environment with a high level of uncertainty must be active (quickly and adequately respond to change) and adaptive (use the experience of changes for further development), while retaining its core competencies. Therefore, from a strategic point of view, the main task of modern management is to establish and maintain a balance of contradictory tendencies – stability and flexibility that will ensure effective operation and development of management object.

Knowing the key factors causing management changes makes it possible to make adaptation and transformation processes controllable, and it is also one of the requirements for the effectiveness of management in modern business environment. The group of technological factors, as a consequence of technological advances, development of technology and new activities, becomes the most obvious and the easiest to identify. These factors, together with other groups of factors, with reference to each other cause the need to transform the existing management systems, technologies, methods, and tools.

In the context of innovative development, when the role of tangible assets in the creation and maintenance of competitive potential decreases, the knowledge technology comes into the picture, which, in order to fully realize its potential, must be balanced by machine technology. New technologies combining potential opportunities for flexibility and stability may play a significant role in solving the main task of strategic management, and therefore ensure the survival and competitiveness of enterprises.

The review of research results by a large number of authors on the forecasting of the results of new technologies adoption (mainly using the example of information technology) allows us to conclude that business priorities must be met, that successful modern enterprises must be high-tech and humane, that high technologies require greater flexibility in enterprises' activity and expectations from new technologies adoption should be restrained.

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